FEED MANUAL AND NOTE BOOK

F. W. WOLL, PH.D.

FEED MANUAL AND NOTE BOOK

FEED MANUAL AND NOTE BOOK

PREPARED BY

F. W. WOLL, PH.D.

PROFESSOR OF ANIMAL NUTRITION, UNIVERSITY OF CALIFORNIA

PHILADELPHIA AND LONDON
J. B. LIPPINCOTT COMPANY

Electrotyped and Printed by J. B. Lippincott Company
The Washington Square Press, Philadelphia, U. S. A.

PREFACE

THIS Manual has been prepared with two main objects in view: *first*, to enable students in agricultural schools and colleges to become thoroughly familiar with our more important feed materials, not only as regards their chemical composition and digestibility, but as to appearance, physical properties, and the various conditions that influence their value for stock feeding; and *second*, to furnish a guide for the use of the feeds in compounding rations that is both scientifically correct and sound from a practical point of view. The aim has been to stimulate independent thinking so that the facts and principles brought out may form a part of the mental equipment of the student that will materially aid him in his later efforts to become a successful stockman.

The plan of the exercises has purposely been made somewhat flexible, for the benefit of teacher and student alike, since local conditions in different sections and states vary greatly, both as to kinds and cost of the available feeding stuffs, and the feeding practices followed; hence, such special problems as are of more direct value in a particular section may be given the preference. The object of the simple tests given in the Manual is to acquaint the student with some of the common impurities or adulterations of feeding stuffs, which may be readily determined in the classroom without any special equipment beyond a few common inexpensive pieces of apparatus. The microscopic identification of components of feeding stuffs, condiments, etc., has not been attempted, since this requires special training in microscopic technique and a knowledge of the anatomy of plant tissues, as well as laboratory facilities, that may not be available for students taking a course in feeding.

The Manual is based primarily on the author's book, "Productive Feeding of Farm Animals,"[1] but it can also be readily used in connection with other text or reference books on this subject. The solution of many of the problems given cannot, however, be found by referring to any one book. The literature on the subject, especially the publications of the various Experi-

[1] J. B. Lippincott Company, Publishers, Philadelphia, Penn., Revised Edition, 1916, 385 pp.

ment Stations or the United States Department of Agriculture, must often be consulted, and in some cases, knowledge drawn from practical feeding experience. It will be found that the interest of the student in the subject will be quickened by this method of instruction, and that it will better prepare him to grapple with the feed problems of the farm later on that will present themselves, than if he were merely required to go through some problems of arithmetic relating to the feeding of stock, however valuable these may be.

February, 1917

CONTENTS

CONTENTS

INTRODUCTION

THE Manual is divided into two parts:

I. Exercises relating to the value of common feeding stuffs used by American stockmen, their chemical composition and digestibility, methods of preparation, examination for purity, relative feeding values, etc.

II. Exercises illustrating calculations of rations for farm animals, the right and wrong uses of the various feeds for feeding cattle, horses, sheep, swine, and poultry, and general problems connected with the feeding of farm stock.

The plan of the exercises follows in general that of the author's "Productive Feeding of Farm Animals"; references in the case of individual exercises are given to the chapters in which the necessary information may be found. In many cases, references given under the literature of the subject at the close of each chapter or in footnotes must be consulted. A number of tests for common impurities and adulterations of feeding stuffs are included in the exercises. These call for some simple inexpensive apparatus, a list of which is given at the back of the book. A standard collection of weed seeds will be found very useful in identifying weed seeds in mixed feeds, grain screenings, etc.

INSTRUCTIONS FOR FILLING OUT FEED BLANKS

Origin.—Give name of locality where grown, or name of manufacturer or feed dealer; in the case of by-products and manufactured feeds, also source and method of manufacture.

Guarantees.—Copy these from the sack or package in which the feed is sold.

Quality.—Factors having a bearing on the quality of the feed are given here: proportionate parts of coarse and fine materials, leaves or stems, flavor, freedom from mustiness or molds.

Value for Feeding Farm Animals.—Designate by a word or two, giving important detailed information of the value for special animals at bottom of page under *General Remarks*, or on back of page. Information as to the value and characteristic properties of the various feeding stuffs will be found under the discussions of the feeds, Productive Feeding, Chapters XII to XX, or in the chapters discussing the feeding of the respective farm animals (Chapters XXI to XXVI).

Chemical Composition.—Average composition: copy from Productive Feeding, Appendix Table I.

Digestion Coefficients.—Copy from the Table near the back of this Manual.

Per Cent Digestible Components.—Obtained by multiplying the per cent of the various components by the respective digestion coefficients given. Differences between the percentages of digestible components thus obtained and the corresponding figures in the last two columns of Productive Feeding, Appendix Table I, that may occur, are of minor importance, in view of the natural variations in the digestibility of the same feeds.

Carbohydrates.—Include nitrogen-free extract and fiber.

Digestible Carbohydrates and Fat.—Equal the sum of digestible carbohydrates and digestible fat, multiplied by 2.25.

Total Digestible Matter.—Equals digestible protein + digestible carbohydrates + digestible fat $\times$ 2.25.

Cost Per Ton and Per Pound.—Give retail price at feed store or as billed.

Weight Per Sack or Per Quart.—Determine the latter by weighing, if practicable; if not, use Appendix Table VI in Productive Feeding; for legal weights of grain, seeds, etc., see the author's "Handbook for Farmers and Dairymen," 6th Edition, page 400.

General Remarks.—Give general importance as a stock feed, special value or limitations as a feed for any class of farm animals, points affecting the value of the feed one way or the other, palatability, flavor, content of certain aromatic or bitter principles, effect on bowels, etc.

A. FEEDING STUFFS

Exercise 1. Green Alfalfa

Fill out the blank spaces below for the feed given. (Reference, Productive Feeding, Chapter XII)

Origin.....

Kinds and per cent of weeds present.....

.....

Stage of maturity.....

Quality of green feed.....

Value for feeding:

Dairy Cows	Beef Cattle	Horses	Swine	Sheep

Chemical Composition, in Per Cent

Green Alfalfa	Average Composition	Digestion Coefficients	Per Cent Digestible Components	Nutritive Ratio
Dry matter.....				
Protein.....				
Fat.....				
Fiber.....				
N-free extract.....				
Ash.....		....	....	
Carbohydrates.....	....	....		
Carbohydrates and fat.....	....	....		1:
Total digestible matter.....	....	....		....

Cost per ton.....per 100 lbs.....

Cost per lb. of digestible matter.....

Exercise 1 (Continued)

General Remarks:

Exercise 2. A Study of Different Kinds of Hay

(Reference, Productive Feeding, Chapter XII)

Examine a sample of such of the following kinds of hay as are available: Timothy hay, mixed timothy and clover, red clover hay, alfalfa hay, hay from mixed grasses, grain hay, prairie hay, etc.

Determine the per cent. of different grasses or legumes in each, foreign materials, weeds, color, freedom from molds or rust, etc. Grade the hay according to the commercial grades adopted by the National Hay Association[1].

Give the various conditions affecting the value of market hay.

[1] Farmers' Bulletin 508; Woll, Handbook for Farmers and Dairymen, 6th Edition, p. 406a.

Exercise 3. Timothy Hay

Fill out the blank spaces below for the feed given. (Reference, Productive Feeding, Chapter XII)

Origin.....

Is it pure?.....

If not, state character and amount of impurities.....

.....

Identify weeds if present.....

Quality of hay.....

Value for feeding:

Dairy Cows	Beef Cattle	Horses	Swine	Sheep

Chemical Composition, in Per Cent

Timothy Hay	Average Composition	Digestion Coefficients	Per Cent Digestible Components	Nutritive Ratio
Dry matter.....				
Protein.....				
Fat.....				
Fiber.....				
N-free extract.....				
Ash.....		....	....	
Carbohydrates.....	....	....		
Carbohydrates and fat.....	....	....		1:
Total digestible matter.....	....	....		....

Cost per ton.....per 100 lbs.....

Cost per lb. of digestible matter.....

Exercise 3 (Continued)

General Remarks:

Exercise 4. Meadow Hay

Fill out the blank spaces below for the feed given. (Reference, Productive Feeding, Chapter XII)

Origin.....

Predominating grasses.....

Is it pure?.....

If not, state character and amount of impurities.....

.....

Identify weeds if present.....

Quality of hay.....

Value for feeding:

Dairy Cows	Beef Cattle	Horses	Swine	Sheep

Chemical Composition, in Per Cent

Meadow Hay	Average Composition	Digestion Coefficients	Per Cent Digestible Components	Nutritive Ratio
Dry matter.....				
Protein.....				
Fat.....				
Fiber.....				
N-free extract.....				
Ash.....		....	....	
Carbohydrates.....	....	....		
Carbohydrates and fat.....	....	....		1:
Total digestible matter.....	....	....		....

Cost per ton.....per 100 lbs.....

Cost per lb. of digestible matter.....

Exercise 4 (Continued)

General Remarks:

Exercise 5. Clover Hay

Fill out the blank spaces below for the feed given. (Reference, Productive Feeding, Chapter XII)

Origin.....

Variety of clover (red, mammoth, alsike, medium, etc.).....

.....

Quality (leafy, stemmy, medium).....

Stage of maturity when cut.....

Kinds and per cent of weeds present.....

Value for feeding:

Dairy Cows	Beef Cattle	Horses	Swine	Sheep

Chemical Composition, in Per Cent

Clover Hay	Average Composition	Digestion Coefficients	Per Cent Digestible Components	Nutritive Ratio
Dry matter.....				
Protein.....				
Fat.....				
Fiber.....				
N-free extract.....				
Ash.....		....	....	
Carbohydrates.....	....	....		
Carbohydrates and fat.....	....	....		1:
Total digestible matter.....	....	....		....

Cost per ton.....per 100 lbs.....

Cost per lb. of digestible nutrients.....

Exercise 5 (Continued)

General Remarks:

Exercise 6. To Calculate the Amount of Hay in a Mow

Rule: Multiply the figures representing the length and the width of the mow in feet, and this product by the average height of hay in the mow. In case of new mixed hay, timothy hay, or only partly filled mows, divide the product by 450. If old and well-packed hay, divide by 400. The quotient will give the approximate number of tons of hay in the mow.

Problem 1: A mow 40 x 36 feet is filled 24 feet deep with newly harvested hay,—how many tons are there in the mow?

Problem 2: How many tons of hay in a mow 36 x 52 feet, filled 28 feet high with old, well-packed hay?

Exercise 7. To Calculate the Amount of Hay in a Stack

Rule: Multiply the width of the stack in feet by the "over" (*i. e.*, the distance from the base of the stack on one side over the top to the base on the other), divide the product by 4, and multiply the quotient by the length. This gives the contents of the stack in cubic feet; for hay that has stood less than 30 days, divide by 512; 30 to 60 days, by 422; over 60 days, by 380. The quotient gives the tonnage of the stack.

Example: A two-months old stack is 30 feet wide by 40 feet "over," and 75 feet long. How many tons of hay does it contain?

Exercise 8. Oat Straw

Fill out the blank spaces below for the feed given. (Reference, Productive Feeding, Chapter XIII)

Origin.....

Is it clean, bright, and free from mustiness?.....

Quality.....

Value for feeding:

Dairy Cows	Beef Cattle	Horses	Swine	Sheep

Chemical Composition, in Per Cent

Oat Straw	Average Composition	Digestion Coefficients	Per Cent Digestible Components	Nutritive Ratio
Dry matter.....				
Protein.....				
Fat.....				
Fiber.....				
N-free extract.....				
Ash.....		....	....	
Carbohydrates.....	....	....		
Carbohydrates and fat.....	....	....		1:
Total digestible matter.....	....	....		....

Cost per ton.....per 100 lbs. (or bale [1]).....

Cost per lb. of digestible nutrients.....

[1] Give dimensions of bale in case of baled straw.

Exercise 8 (Continued)

General Remarks:

Exercise 9. Corn Silage

Fill out the blank spaces below for the feed given. (Reference, Productive Feeding, Chapter XV)

Origin.....

Quality.....

Is there any moldy or decayed silage in the sample?.....

.....

Flavor.....

How long since silo was filled?.....How long since sample was taken?.....

Maturity of corn when cut for the silo.....

Approximate proportion of grain in sample.....

Value for feeding:

Dairy Cows	Beef Cattle	Horses	Swine	Sheep

Chemical Composition, in Per Cent

Corn Silage	Average Composition	Digestion Coefficients	Per Cent Digestible Components	Nutritive Ratio
Dry matter.....				
Protein.....				
Fat.....				
Fiber.....				
N-free extract.....				
Ash.....		....	....	
Carbohydrates.....	....	....		
Carbohydrates and fat.....	....	....		1:
Total digestible matter.....	....	....		....

Exercise 9 (Continued)

Estimated cost per ton.....per 100 lbs.....

Cost per lb. of digestible nutrients.....

General Remarks:

Exercise 10. To Calculate the Amount of Silage in Silos

Calculate the content of the silo in cubic feet, and divide by 50. The quotient will give the number of tons of silage in the silo. The figure 50 is obtained by dividing 2000 by 40, the average weight of a cubic foot of Indian corn silage. In the case of a cylindrical silo, the cubical content is obtained by multiplying the square of the radius (one-half the diameter) by the height, and the product by 3.14.

The weight of a cubic foot of silage in the lower half of the silo, for silage made from nearly matured Indian corn, or from legumes at beginning bloom, may be estimated at 50 pounds, on the average, and that in the upper half at 35 pounds. In case of non-saccharine sorghums, milo, kafir, etc., small grains, alfalfa or clover somewhat wilted or cut at a rather advanced stage of maturity, twenty-five per cent may be deducted from the estimated capacity thus obtained.

Example : How many tons of silage will a silo hold, 18 feet in diameter, 36 feet high, if filled with Indian corn cut with kernels in the roasting stage?

Example 2: How many tons of Indian corn silage are left in the lower half of a 36-foot silo, 16 feet in diameter? How many tons of milo silage?

Exercise 11. The Silo on the Stock Farm

Explain the relation between the feeding surface of silage (the diameter of the silo) and the size of the dairy herd to be fed.

What are the outside limits for the diameter of silos adapted to practical farm conditions?

Example 1: How large should a silo be built, and how large a field should be planted to Indian corn, for supplying a herd of 25 cows, to be fed 30 pounds of silage per head daily for a period of 150 days?

Example 2: How long will the silage last in a completely filled silo, 16 feet in diameter, 36 feet high, when fed at the rate of 28 pounds per head daily to a herd of 35 dairy cows?

Example 3: How can a silo be filled twice during the year with crops grown on the same land (applies to the southern and southwestern states mainly)? Mention silage crops to be grown; give approximate time of sowing or planting, and cutting the crop for the silo, and feeding the silage, in case of both crops.

Example 4: Corn silage in a 16-foot silo filled 35 feet deep will be fed to a herd of 28 milch cows, to 12 steers and to 150 sheep at the rate of, respectively, 35, 24, and 3 pounds per head daily. How long will the silage last?

Exercise 12. A Study of Market Prices of Feeding Stuffs

Compute the weekly market quotations of the feeds given in the following list from one of the main agricultural papers of the state, preferably for a period of several years. Several feeds may be assigned to each student in order that a longer period may be compared and the figures obtained may have general value. Where no market quotations are available, the cost given in the feed bulletins of the various experiment stations or the feed inspection bureaus may be used. In the case of feeds where no market quotations or prices are available, the figures for local prices to be adopted should be decided after careful consideration and discussion in the class:

Roughage

Timothy hay
Mixed timothy and clover
Red clover hay
Alfalfa hay
Hay from mixed grasses (meadow hay)
Grain hay
Prairie hay
Pea-vine hay
Pasture
Green sorghum
Corn stover
Oat straw
Corn silage
Alfalfa silage
Mangels
Sugar beets

Exercise 12 (Continued)

Concentrates

Indian corn
Corn-and-cob meal
Oats
Barley
Wheat
Milo
Wheat bran
Wheat middlings
Red dog flour
Hominy feed
Gluten feed
Buckwheat middlings
Buckwheat feed
Dried brewers' grains
Malt sprouts
Dried distillers' grains
Linseed meal
Cottonseed meal
Cottonseed hulls
Coconut meal
Dried beet pulp
Molasses beet pulp
Molasses
Skim milk
Whole milk
Tankage

Exercise 13. Preliminary Study of Concentrated Feeds

1. Give a list of six common stock feeds in your state that are chiefly valuable on account of their protein contents; likewise a list of six feeding stuffs that are classed as carbohydrate or starchy feeds, of six that are especially high in fat (oil), and of six that are especially high in fiber.

High-protein Feeds

1.....

2.....

3.....

4.....

5.....

6.....

Carbohydrate Feeds

1.....

2.....

3.....

4.....

5.....

6.....

Feeds High in Fat

1.....

2.....

3.....

4.....

5.....

6.....

Feeds High in Fiber

1.....

2.....

3.....

4.....

5.....

6.....

2. Obtain samples weighing about a pound each of as many concentrated feeds as can be found in the local feed stores; note the guarantees on the sacks in each case and the retail cost of each feed per ton and per 100 pounds; tabulate the figures either in the note book or on the blackboard and make comparisons between the cost and the digestible components, energy and feed-unit values.[1] Place the feeds in the order of increasing cost, according to the three methods of comparison, and discuss the results obtained (Productive Feeding, Chapter X).

[1] Productive Feeding, Tables I, III, IV in Appendix.

Exercise 14. Tests for Adulterations of Concentrates

Examination for impurities: Separate samples of 100 grams of the feed into three portions,—coarse, medium and fine, by means of two sieves, 20- and 80-mesh (or into two portions by means of 50-mesh sieve). Examine carefully each part for foreign matter: hulls (oats, rice, barley, buckwheat), grain screenings, whole weed seeds, elevator or mill sweepings, ground corn cobs, sawdust, ground stone pits (olive, brazil nuts), ground peanut hulls, ground coffee hulls, sand, etc.

Examination for moldiness: 5 grams of the ground sample are mixed with distilled water, poured on a Petri dish (or a saucer) and kept at 80 to 100 degrees F. for 24 hours or more. Examine for colonies of molds or bacteria with a magnifier and compare these with those found in the case of similar feeds of known purity.

Weed seeds in concentrates: Separate and count the weed seeds in (a) 10 grams and (b) 20 grams of the thoroughly mixed feed sample and calculate the average of the two. Determine their number in one pound and one ton of the feed (one pound Avoirdupois equals 453 grams).

Identify as many of the weed seeds as possible by comparison with a standard collection of weed seeds, and give the number of noxious weeds in the sample. (A collection of 200 economic seeds is prepared for schools by the Bureau of Plant Industry, U. S. Dept. of Agriculture).

Sand and mineral impurities: Place a tablespoonful of the feed in a tumbler, fill this three-fourths full with water, stir vigorously and pour off carefully the turbid liquid; repeat this until the top liquid is clear. The sediment will consist of sand, calcium carbonate, gypsum, or other mineral impurities, most of which may be readily identified. The per cent present may be determined approximately by drying and weighing the sediment, provided a definite amount of feed was weighed out, *e. g.*, 20 grams.

Exercise 15. Indian Corn (Corn Meal[1])

Fill out the blank spaces below for the feed given. (Reference, Productive Feeding, Chapter XVI)

Origin.....

Race and variety.....

Quality (hard or soft, plump or shrunken, dry or damp, etc.).....

Impurities.....

Value for feeding:

Dairy Cows	Beef Cattle	Horses	Swine	Sheep

Chemical Composition, in Per Cent

Indian Corn	Average Composition	Digestion Coefficients	Per Cent Digestible Components	Nutritive Ratio
Dry matter.....				
Protein.....				
Fat.....				
Fiber.....				
N-free extract.....				
Ash.....		....	....	
Carbohydrates.....	....	....		
Carbohydrates and fat.....	....	....		1:
Total digestible matter.....	....	....		....

[1] If corn meal, separate 50 grams of the sample in two portions by means of a 50-mesh sieve. Weigh each portion and calculate per cent of fine- and coarse-ground. Also examine for odor, moldiness or mustiness.

Exercise 15 (Continued)

Cost per ton.....per lb.....

Cost per lb. of digestible nutrients.....

Weight of 1 bushel.....1 quart.....

General Remarks:

.....

.....

Exercise 16. Corn-and-Cob Meal

Fill out the blank spaces below for the feed given. (Reference, Productive Feeding, Chapter XVII)

Origin.....

Guarantees: Per cent protein.....Per cent fat.....Per cent fiber (max.).....

Purity.....

Identify weed seeds, if present.....

Quality.....

Value for feeding:

Dairy Cows	Beef Cattle	Horses	Swine	Sheep

Chemical Composition, in Per Cent

Corn and Cob Meal	Average Composition	Digestion Coefficients	Per Cent Digestible Components	Nutritive Ratio
Dry matter.....				
Protein.....				
Fat.....				
Fiber.....				
N-free extract.....				
Ash.....		....	....	
Carbohydrates.....	....	....		
Carbohydrates and fat.....	....	....		1:
Total digestible matter.....	....	...		....

Cost per ton.....per lb.....

Cost per lb. of digestible nutrients.....

General Remarks:

.....

.....

Exercise 17. To Measure Corn in Cribs

When the crib is equilateral: Multiply the length by the breadth, and that again by the height, all expressed in inches, and divide the product by 2748 (the number of cubic inches in a heaped bushel); the quotient will be the number of bushels of ears. Two-thirds of the quotient will represent the number of bushels of shelled corn.

Example: Find the number of bushels of shelled corn contained in a crib 12 feet long by 6 feet wide and 8 feet high, filled with ear corn.

When the crib is flared at the sides: Multiply half the sum of the top and bottom width by the perpendicular height, all expressed in inches, and that again by the length in inches, and divide the product by 2748; the quotient will be the number of heaped bushels of ears. Two-thirds of the quotient will represent the number of bushels of shelled corn.

Exercise 18. Oats

Fill out the blank spaces below for the feed given. (Reference, Productive Feeding, Chapter XVI)

Origin.....

Quality (well cleaned, heavy or light oats, clipped or bleached).....

.....

Impurities.....

Value for feeding:

Dairy Cows	Beef Cattle	Horses	Swine	Sheep

Chemical Composition, in Per Cent

Oats	Average Composition	Digestion Coefficients	Per Cent Digestible Components	Nutritive Ratio
Dry matter.....				
Protein.....				
Fat.....				
Fiber.....				
N-free extract.....				
Ash.....		....	...	
Carbohydrates.....	....	....		
Carbohydrates and fat.....	....	....		1:
Total digestible matter.....	....	....		....

Cost per ton.....per lb.....

Cost per pound of digestible nutrients.....

Weight of 1 bushel.....1 quart.....

General Remarks:

.....

.....

Exercise 19. To Determine Per Cent of Hulls in Oats

Weigh out and examine carefully two lots of 100 oat kernels from a well-mixed sample of oats, and record the weights below. Separate the hulls of the kernels in each lot by means of a scalpel or penknife, and weigh them carefully; also any impurities that may be present. Calculate the percentage of this weight to that of the whole oats.

	Weight of Oats	Weight of Hulls	Per cent Hulls
Sample 1.....			
Sample 2.....			
		Average.....	

What is an average figure for per cent of hulls in heavy, medium, and light oats?

Exercise 20. Corn and Oats, "Ground Feed"

Fill out the blank spaces below for the feed given. (Reference, Productive Feeding, Chapter XVII)

Origin .....

Guarantees: Per cent protein .....Per cent fat .....Per cent fiber (max.) .....

Purity .....

Identify weed seeds if present .....

Fineness of feed (per cent passing through a 50-mesh sieve) .....

Odor (fresh, damp, musty) .....

Quality .....

Value for feeding:

Dairy Cows	Beef Cattle	Horses	Swine	Sheep

Chemical Composition, in Per Cent

Corn and Oats	Average Composition	Digestion Coefficients[1]	Per Cent Digestible Components	Nutritive Ratio
Dry matter.....				
Protein.....				
Fat.....				
Fiber.....				
N-free extract.....				
Ash.....		....	....	
Carbohydrates.....	....	....		
Carbohydrates and fat.....	....	....		1:
Total digestible matter.....	....	....		....

Cost per ton.....per lb.....

Cost per lb. digestible nutrients.....

General Remarks:

.....

[1] Assuming "Ground Feed" was composed of equal parts, by weight, of corn and oats.

Exercise 21. Barley

Fill out the blank spaces below for the feed given. (Reference, Productive Feeding, Chapter XVII)

Origin .....

Quality (well cleaned, plump, bright, freedom from other grains) .....

Mechanical condition (whole, ground, rolled) .....

Impurities .....

Value for feeding:

Dairy Cows	Beef Cattle	Horses	Swine	Sheep

Chemical Composition, in Per Cent

Barley	Average Composition	Digestion Coefficients	Per Cent Digestible Components	Nutritive Ratio
Dry matter.....				
Protein.....				
Fat.....				
Fiber.....				
N-free extract.....				
Ash.....		....	....	
Carbohydrates.....	....	....		
Carbohydrates and fat.....	....	....		1:
Total digestible matter.....	....	....		....

Cost per ton.....per lb.....

Cost per lb. of digestible nutrients .....

Weight of 1 bushel.....1 quart.....

General Remarks:

.....

.....

Exercise 22. Milo Maize (or Other Grain Sorghums)

Fill out the blank spaces below for the feed given. (Reference, Productive Feeding, Chapter XVI)

Origin.....

Strain and variety.....

Quality.....

Impurities.....

Value for feeding:

Dairy Cows	Beef Cattle	Horses	Swine	Sheep

Chemical Composition, in Per Cent

Milo Maize	Average Composition	Digestion Coefficients	Per Cent Digestible Components	Nutritive Ratio
Dry matter.....				
Protein.....				
Fat.....				
Fiber.....				
N-free extract.....				
Ash.....		....	....	
Carbohydrates.....	....	....		
Carbohydrates and fat.....	....	....		1:
Total digestible matter.....	....	....		....

Cost per ton.....per lb.....

Cost per lb. of digestible nutrients.....

Weight of 1 bushel.....1 quart.....

General Remarks:

.....

.....

Exercise 23. Grain Screenings

(Reference, Productive Feeding, Chapter XVI)

Weigh out two portions of 10 grams each and separate them into four different parts as follows: (1) kernels of grains or other economic plants, (2) weed seeds, (3) chaff, straw, etc., and (4) dirt, sand, etc.

Weigh each portion separately and calculate the per cent in the screenings. Identify as many of the different weed seeds as possible by comparison with a standard seed collection.

Weigh separately the weed seeds present in large numbers and calculate the per cent in the screenings.

Identify noxious and poisonous weed seeds in the sample, giving the number of each, and calculate the number in one pound and one ton of the screenings.

Composition of Grain Screenings.

10 Grams Contained	Sample 1		Sample 2		Average Per Cent
	Weight	Per Cent	Weight	Per Cent	
1. Kernels of grains, etc.....					
2. Weed seeds.....					
3. Chaff, straw, etc.....					
4. Dirt and sand.....					

Noxious Weeds Present in 10 Grams of Screenings

Name	Weight	Per Cent	Number	Number in	
				1 Pound	1 Ton

Exercise 24. Wheat Bran

Fill out the blank spaces below for the feed given. (Reference, Productive Feeding, Chapter XVII)

Origin .....

Guarantees: Per cent fat.....Per cent protein.....Per cent fiber (max.).....

Quality (Roller or Country-mill, freedom from mustiness or molds).....

Proportion of floury material.....

Impurities.....

Number of whole weed seeds in 10 grams.....

Value for feeding:

Dairy Cows	Beef Cattle	Horses	Swine	Sheep

Chemical Composition, in Per Cent

Wheat Bran	Average Composition	Digestion Coefficients	Per Cent Digestible Components	Nutritive Ratio
Dry matter.....				
Protein.....				
Fat.....				
Fiber.....				
N-free extract.....				
Ash.....		....	....	
Carbohydrates.....	....	....		
Carbohydrates and fat.....	....	....		1:
Total digestible matter.....	....	....		....

Cost per ton.....per lb.....

Cost per lb. of digestible nutrients.....

Weight of sacks.....1 quart.....

Exercise 24 (Continued)

General Remarks:

Exercise 25. Wheat Middlings

Fill out the blank spaces below for the feed given. (Reference, Productive Feeding, Chapter XV)

Origin.....

Guarantees: Per cent protein.....Per cent fat.....Per cent fiber (max.).....

Kind of middlings (flour, standard or shorts).....

Quality (proportion of flour, freedom from mustiness or molds).....

Are ground screenings or whole weed seeds found in sample?.....

Value for feeding:

Dairy Cows	Beef Cattle	Horses	Swine	Sheep

Chemical Composition, in Per Cent

Wheat Middlings	Average Composition	Digestion Coefficients	Per Cent Digestible Components	Nutritive Ratio
Dry matter.....				
Protein.....				
Fat.....				
Fiber.....				
N-free extract.....				
Ash.....		....	....	
Carbohydrates.....	....	....		
Carbohydrates and fat.....	....	....		1
Total digestible matter.....	....	....		....

Cost per ton.....per lb.....

Cost per lb. of digestible nutrients.....

Weight per sack.....per quart.....

General Remarks:

Exercise 26. Red Dog Flour

Fill out the blank spaces below for the feed given. (Reference, Productive Feeding, Chapter XV)

Origin .....

Guarantees: Per cent protein .....Per cent fat .....Per cent fiber (max.).....

Quality .....

Impurities .....

Value for feeding:

Dairy Cows	Beef Cattle	Horses	Swine	Sheep

Chemical Composition, in Per Cent

Red Dog Flour	Average Composition	Digestion Coefficients	Per Cent Digestible Components	Nutritive Ratio
Dry matter.....				
Protein.....				
Fat.....				
Fiber.....				
N-free extract.....				
Ash.....		....	....	
Carbohydrates.....	....	....		
Carbohydrates and fat.....	....	....		1:
Total digestible matter.....	....	....		....

Cost per ton.....per lb.....

Cost per lb. of digestible nutrients .....

Weight per sack.....per quart.....

General Remarks:

.....

.....

Exercise 27. Buckwheat Feed

Fill out the blank spaces below for the feed given. (Reference, Productive Feeding, Chapter XVII)

Origin .....

Guarantees .....

Quality .....

Per cent hulls .....floury materials [1] ....

Value for feeding:

Dairy Cows	Beef Cattle	Horses	Swine	Sheep

Chemical Composition, in Per Cent

Buckwheat Feed	Average Composition	Digestion Coefficients	Per Cent Digestible Components	Nutritive Ratio
Dry matter.....				
Protein.....				
Fat.....				
Fiber.....				
N-free extract.....				
Ash.....		....	....	
Carbohydrates.....	....	....		
Carbohydrates and fat.....	....	....		1:
Total digestible matter.....	....	....		....

Cost per ton .....per lb.....

Cost per lb. of digestible nutrients.....

Weight per sack .....1 quart.....

General Remarks:

.....

.....

[1] See following exercise.

Exercise 28. A, To Determine Per Cent of Hulls in Buckwheat Feed

Weigh out 100 grams of the thoroughly mixed sample and separate it into two portions by means of a 50-mesh sieve. Weigh each portion, repeat the experiment and average the results. Calculate percentages of hulls and middlings present in the sample.

	Sample 1.		Sample 2		Average Per Cent
	Weight	Per Cent	Weight	Per Cent	
Hulls.....					
Middlings.....					
			Total.....		

B, Test for Rice Hulls

Pure rice bran and rice meal contain considerable fat, and are not moistened if placed on the surface of water. When a teaspoonful of a sample of rice bran or rice meal adulterated with hulls is placed on the surface of water in a tumbler the hulls will soon sink into the water. Make the test with a sample of rice bran or meal of known purity for comparison.

Exercise 29. Gluten Feed

Fill out the blank spaces below for the feed given. (Reference, Productive Feeding, Chapter XVII)

Origin .....
Guarantees: Per cent fat.....Per cent protein.....Per cent fiber (max.).....
Quality .....
Impurities .....
Is it artificially colored? [1].....
Value for feeding:

Dairy Cows	Beef Cattle	Horses	Swine	Sheep

Chemical Composition, in Per Cent

Gluten Feed	Average Composition	Digestion Coefficients	Per Cent Digestible Components	Nutritive Ratio
Dry matter.....				
Protein.....				
Fat.....				
Fiber.....				
N-free extract.....				
Ash.....		....	....	
Carbohydrates.....	....	....		
Carbohydrates and fat.....	....	....		1:
Total digestible matter.....	....	....		....

Cost per ton.....per lb.....
Cost per lb. of digestible nutrients.....
Weight of sacks.....1 quart.....
General Remarks:
.....

[1] If so stated on sacks; may be determined by noting the color of the water extract.

Exercise 30. Dried Beet Pulp

Fill out the blank spaces below for the feed given. (Reference, Productive Feeding, Chapter XIII)

Origin.....

Is it plain dried beet pulp or dried molasses beet pulp?.....

Is it clean, bright and free from mustiness, or lumpy?.....

Color.....

Quality.....

Value for feeding:

Dairy Cows	Beef Cattle	Horses	Swine	Sheep

Chemical Composition, in Per Cent

Beet Pulp	Average Composition	Digestion Coefficients	Per Cent Digestible Components	Nutritive Ratio
Dry matter.....				
Protein.....				
Fat.....				
Fiber.....				
N-free extract.....				
Ash.....		....	....	
Carbohydrates.....	....	....		
Carbohydrates and fat.....	....	....		1:
Total digestible matter.....	....	....		....

Cost per ton.....per 100 lbs.....

Cost per lb. of digestible nutrients.....

Weight per sack.....per quart.....

General Remarks:

.....

Exercise 31. Test of Water-Absorption by Dried Beet Pulp

Weigh out 10 grams of the dried pulp and place in a beaker with 100 c.c. of water, mix well by stirring with a glass rod or spoon and cover with a watch glass. Leave standing until the following day or at least 6 to 8 hours. Pour off and weigh excess of water and figure ratio of amount of water absorbed to weight of pulp.

Repeat experiment with a sample of dried molasses beet pulp.

Exercise 32. Dried Brewers' Grains

Fill out the blank spaces below for the feed given. (Reference, Productive Feeding, Chapter XVII)

Origin .....

Guarantees: Per cent protein .....Per cent fat .....Per cent fiber (max.) .....

Purity .....

Cereal grains identified in sample .....

Quality .....

Value for feeding:

Dairy Cows	Beef Cattle	Horses	Swine	Sheep

Chemical Composition, in Per Cent

Dried Brewers' Grains	Average Composition	Digestion Coefficients	Per Cent Digestible Components	Nutritive Ratio
Dry matter				
Protein				
Fat				
Fiber				
N-free extract				
Ash	....	....		
Carbohydrates	....	....		
Carbohydrates and fat	....	....		1:
Total digestible matter	....	....		....

Cost per ton .....per lb. .....

Cost per lb. digestible nutrients .....

Weight per sack .....per quart .....

Exercise 32 (Continued)

General Remarks:

Exercise 33. Dried Distillers' Grains

Fill out the blank spaces below for the feed given. (Reference, Productive Feeding, Chapter XVII)

Origin.....

Guarantees: Per cent protein.....Per cent fat.....Per cent fiber (max.).....

Cereal grains identified in sample .....

Purity.....

Identify weed seeds if present.....

Quality.....

Value for feeding:

Dairy Cows	Beef Cattle	Horses	Swine	Sheep

Chemical Composition, in Per Cent

Dried Distillers' Grains	Average Composition	Digestion Coefficients	Per Cent Digestible Components	Nutritive Ratio
Dry matter.....				
Protein.....				
Fat.....				
Fiber.....				
N-free extract.....				
Ash.....	....	....	....	
Carbohydrates.....	....	....		
Carbohydrates and fat.....	....	....		1:
Total digestible matter	....	....		....

Cost per ton.....per lb.....

Cost per lb. of digestible nutrients.....

Weight per sack.....per quart.....

Exercise 33 (Continued)

General Remarks:

Exercise 34. Linseed Meal

Fill out the blank spaces below for the feed given. (Reference, Productive Feeding, Chapter XVII)

Origin .....

Guarantees: Per cent protein.....Per cent fat.....Per cent fiber (max.) .....

Is it old-process or new-process meal? (See following exercise) .....

Quality .....

Mechanical condition (fine- or coarse-ground, pea size, etc.) .....

Impurities .....

Value of feeding:

Dairy Cows	Beef Cattle	Horses	Swine	Sheep

Chemical Composition, in Per Cent

Linseed Meal	Average Composition	Digestion Coefficients	Per Cent Digestible Components	Nutritive Ratio
Dry matter.....				
Protein				
Fat.....				
Fiber.....				
N-free extract.....				
Ash.....	....		....	
Carbohydrates.....	....	....		
Carbohydrates and fat	....	....		1:
Total digestible matter.....	....	....		....

Cost per ton.....per lb.....

Cost per lb. of digestible nutrients.....

Weight of sacks.....1 quart.....

Exercise 34 (Continued)

General Remarks:

Exercise 35. The Swelling Test for Linseed Meal

Pulverize a small amount of the meal and place a level teaspoonful of it in a tumbler; add 10 teaspoonfuls of boiling hot water to the meal. Stir thoroughly and allow to settle. Old-process meal will remain jelly-like on standing, while the new-process meal will settle in the course of an hour and leave a clear yellowish solution on top. See Fig. 38 in Productive Feeding.

About what proportion of clear water is left on top in case of each sample?

Test for starch: Add a few drops of iodine solution to the clear liquid in each tumbler and note the color. Is starch present in either case?

A more delicate test for starch may be made by placing a very small amount of the finely pulverized meal on a slide, mixing it with a couple of drops of distilled water, and adding a drop of iodine solution. Examine under microscope for blue-colored specks. Starch is not present in meal made from clean, well-matured flaxseed.

Exercise 36. Cottonseed Meal

Fill out the blank spaces below for the feed given. (Reference, Productive Feeding, Chapter XVII)

Origin .....

Guarantees: Per cent protein.....Per cent fat.....Per cent fiber (max.).....

Color .....

Quality .....

Impurities (see following exercise) .....

Is it fine or coarse-ground, pea or nut size, etc? .....

Value for feeding:

Dairy Cows	Beef Cattle	Horses	Swine	Sheep

Chemical Composition, in Per Cent

Cottonseed Meal	Average Composition	Digestion Coefficients	Per Cent Digestible Components	Nutritive Ratio
Dry matter.....				
Protein.....				
Fat.....				
Fiber.....				
N-free extract.....				
Ash.....		....	....	
Carbohydrates.....	....	....		
Carbohydrates and fat.....	....	....		1:
Total digestible matter.....	....	....		....

Cost per ton.....per lb.....

Cost per lb. of digestible nutrients .....

Weight of sacks.....1 quart.....

General Remarks:

Exercise 37. Test for Impurities in Cottonseed Meal

Place a teaspoonful of the meal in a tumbler and pour over it 1½ to 2 oz. of hot water. Stir the mass until it is thoroughly wet and all the particles are floating. Allow it to subside for from 5 to 10 seconds and pour off. If a large amount of fine, dark-brown sediment has settled in this time (a sediment noticeably heavier than the fine mustard-yellow meal and one which upon repeated treatments with boiling hot water keep settling out) the goods are a *feed meal, i. e.*, meal containing relatively large quantities of ground hulls. All meals contain small quantities of hulls and show dark specks. If, however, there is found a large amount of this residue, one which persists in remaining after several washings and decantings, it is surely composed of hulls and the goods are a feed meal or an adulterated cottonseed meal.

The results of the test are very striking when a feed meal is compared with a meal of known purity, which is similarly tested at the same time (Vermont station).

Question 1: How many pounds of cottonseed meal, hulls and oil are obtained, on the average, from a ton of cottonseed in modern mills?

Question 2: What are the relative values of cottonseed meal and Indian corn for feeding farm animals?

Exercise 38. Coconut Meal

Fill out the blank spaces below for the feed given. (Reference, Productive Feeding, Chapter XVIII)

Origin.....

Guarantees: Per cent protein.....Per cent fat.....Per cent fiber (max.).....

Quality.....

Flavor (pure, aromatic or rancid) .....

Is it lumpy?.....

Impurities.....

Value of feeding:

Dairy Cows	Beef Cattle	Horses	Swine	Sheep

Chemical Composition, in Per Cent

Coconut Meal	Average Composition	Digestion Coefficients	Per Cent Digestible Components	Nutritive Ratio
Dry matter.....				
Protein.....				
Fat.....				
Fiber.....				
N-fiber extract.....				
Ash.....		....	....	
Carbohydrates.....	....	....		
Carbohydrates and fat...	....	....		1:
Total digestible matter....	....	....	....	....

Cost per ton.....per lb.....

Cost per lb. of digestible nutrients.....

Weight of sacks.....1 quart.....

General Remarks:

.....

Exercise 39. Tankage

Fill out the blank spaces below for the feed given. (Reference, Productive Feeding, Chapter XIX)

Origin.....

Guarantees: Per cent protein.....Per cent calcium phosphate.....

Purity.....

Quality.....

Value for feeding:

Dairy Cows	Beef Cattle	Horses	Swine	Sheep

Chemical Composition, in Per Cent

Tankage	Average Composition	Digestion Coefficients	Per Cent Digestible Components	Nutritive Ratio
Dry matter.....				
Protein.....				
Fat.....				
Fiber.....				
N-free extract.....				
Ash.....				
Carbohydrates.....	....	....		
Carbohydrates and fat.....	....	....		1:
Total digestible matter.....	....	....		....

Cost per ton.....per lb.....

Cost per lb. digestible nutrients.....per lb. digestible protein.....

General Remarks:

.....

.....

Exercise 40*a*. Name of Feed.....

Fill out the blank spaces below for the feed given. (Mixed dairy, horse, or swine feeds, calf meals, miscellaneous feeds).

Origin.....

Guarantees: Per cent protein.....Per cent fat.....Per cent fiber (max.).....

Purity.....

Are whole weed seeds present?.....

If so, identify the main kinds and determine number of noxious weeds in one pound....

.....

Value for feeding:

Dairy Cows	Beef Cattle	Horses	Swine	Sheep

Chemical Composition, in Per Cent

	Average Composition	Digestion Coefficients	Per Cent Digestible Components	Nutritive Ratio
Dry matter.....				
Protein.....				
Fat.....				
Fiber.....				
N-free extract.....				
Ash.....		....	....	
Carbohydrates.....	....	....		
Carbohydrates and fat.....	....	....		1:
Total digestible matter.....	....	....		....

Cost per ton.....per 100 lbs.....

Cost per lb. of digestible matter.....

General Remarks:

.....

.....

EXERCISE 40*b*. NAME OF FEED.....

Fill out the blank spaces below for the feed given.

Origin.....

Guarantees: Per cent protein.....Per cent fat.....Per cent fiber (max.).....

Purity.....

Are whole weed seeds present?.....

If so, identify the main kinds and determine number of noxious weeds in one pound....

.....

Value for feeding:

Dairy Cows	Beef Cattle	Horses	Swine	Sheep

Chemical Composition, in Per Cent

	Average Composition	Digestion Coefficients	Per Cent Digestible Components	Nutritive Ratio
Dry matter.....				
Protein.....				
Fat.....				
Fiber.....				
N-free extract.....				
Ash.....		....	....	
Carbohydrates.....	....	....		
Carbohydrates and fat.....	....	....		1:
Total digestible matter.....	....	....		....

Cost per ton.....per 100 lbs.....

Cost per lb. of digestible matter .....

General Remarks:

.....

.....

Exercise 40c. Name of Feed.....

Fill out the blank spaces below for the feed given.

Origin.....

Guarantees: Per cent protein.....Per cent fat.....Per cent fiber (max.).....

Purity.....

Are whole weed seeds present?.....

If so, identify the main kinds and determine number of noxious weeds in one pound....

.....

Value for feeding:

Dairy Cows	Beef Cattle	Horses	Swine	Sheep

Chemical Composition, in Per Cent

	Average Composition	Digestion Coefficients	Per Cent Digestible Components	Nutritive Ratio
Dry matter.....				
Protein.....				
Fat.....				
Fiber.....				
N-free extract.....				
Ash.....		....	....	
Carbohydrates.....	....	....		
Carbohydrates and fat.....	....	...		1:
Total digestible matter.....	....	....		....

Cost per ton.....per 100 lbs.....

Cost per lb. of digestible matter.....

General Remarks:

.....

.....

EXERCISE 40*d*. NAME OF FEED.....

Fill out the blank spaces below for the feed given.

Origin .....

Guarantees: Per cent protein .....Per cent fat .....Per cent fiber (max.).....

Purity .....

Are whole weed seeds present? .....

If so, identify the main kinds and determine number of noxious weeds in one pound....

.....

Value for feeding:

Dairy Cows	Beef Cattle	Horses	Swine	Sheep

Chemical Composition, in Per Cent

	Average Composition	Digestion Coefficients	Per Cent Digestible Components	Nutritive Ratio
Dry matter.....				
Protein.....				
Fat.....				
Fiber.....				
N-free extract.....				
Ash.....		....	....	
Carbohydrates.....	....	....		
Carbohydrates and fat.....	....	....		1:
Total digestible matter.....	....	....		....

Cost per ton.....per 100 lbs.....

Cost per lb. of digestible matter.....

General Remarks:

.....

.....

Exercise 40*e*. Name of Feed.....

Fill out the blank spaces below for the feed given.

Origin.....

Guarantees: Per cent protein.....Per cent fat.....Per cent fiber (max.).....

Purity.....

Are whole weed seeds present?.....

If so, identify the main kinds and determine number of noxious weeds in one pound....

.....

Value for feeding:

Dairy Cows	Beef Cattle	Horses	Swine	Sheep

Chemical Composition, in Per Cent

	Average Composition	Digestion Coefficients	Per Cent Digestible Components	Nutritive Ratio
Dry matter.....				
Protein.....				
Fat.....				
Fiber.....				
N-free extract.....				
Ash.....		....	....	
Carbohydrates.....	....	....		
Carbohydrates and fat.....	....	....		1:
Total digestible matter.....	....	....		....

Cost per ton.....per 100 lbs.....

Cost per lb. of digestible matter.....

General Remarks:

.....

.....

EXERCISE 40*f*. NAME OF FEED.....

Fill out the blank spaces below for the feed given.

Origin.....

Guarantees: Per cent protein.....Per cent fat.....Per cent fiber (max.).....

Purity.....

Are whole weed seeds present?.....

If so, identify the main kinds and determine number of noxious weeds in one pound....

.....

Value for feeding:

Dairy Cows	Beef Cattle	Horses	Swine	Sheep

Chemical Composition, in Per Cent

	Average Composition	Digestion Coefficients	Per Cent Digestible Components	Nutritive Ratio
Dry matter.....				
Protein.....				
Fat.....				
Fiber.....				
N-free extract.....				
Ash.....		....	....	
Carbohydrates.....	....	....		
Carbohydrates and fat.....	....	....		1:
Total digestible matter.....	....	....		....

Cost per ton.....per 100 lbs.....

Cost per lb. of digestible matter.....

General Remarks:

.....

.....

Exercise 41. Condimental Stock Feeds

(Reference, Productive Feeding, Chapter XX)

Secure a few samples of condimental stock feeds and try to identify some of their ingredients.

1. What kind of a filler do they contain? Estimate the proportion of stock feed made up by the filler.

2. Are charcoal, salt, sulphur, or any special drug or drugs to be distinguished?

3. Compare the cost of a pound of stock feed with the approximate cost of the filler and other ingredients thereof, in so far as these have been identified.

Exercise 42. The Feed-Unit System

(Reference, Productive Feeding, Chapter IX)

1. A cow freshened December 12, 1913, and was milked until February 4, 1915. During this time she produced 18459.2 pounds milk containing 667.79 pounds butter fat, and consumed the following amounts of feed:

5,385 pounds alfalfa hay.
4,423 pounds corn silage.
640 pounds mangels.
7,111 pounds green alfalfa.
1,760 pounds green barley.
386 pounds green corn.
1554.3 pounds wheat bran.
1169.9 pounds rolled barley.
927.8 pounds rolled oats.
363.9 pounds linseed meal.
455.7 pounds coconut meal.
1420.4 pounds dried beet pulp.
Her average weight during this time was 1400 pounds.

2. Another cow in the same herd freshened February 6, 1914, and milked until January 21, 1915. During this time she produced 6058.9 pounds milk containing 213.55 pounds butter fat; her feed consumption was as follows:

5091 pounds alfalfa hay.
2228 pounds corn silage.
9495 pounds green alfalfa.
1369 pounds green barley.
571 pounds bran.
595 pounds rolled barley.
373 pounds rolled oats.
142 pounds linseed meal.
222 pounds coconut oil meal
153 pounds dried beet pulp.
Her average weight was 1450 pounds during this time.

Exercise 42 (Continued)

Figure out for each cow:

	1st cow	2nd cow
1. Cost of a gallon of milk 2. Cost of a pound of fat } at current feed prices		
3. Number of feed units eaten by each cow		
4. Number of feed units per gallon of milk		
5. Number of feed units per pound of fat		
6. Number of feed units required for each cow, according to the feed-unit standard		

Exercise 43. Comparisons of Relative Economy of Feeding Stuffs

(Reference, Productive Feeding, Chapter X)

Problem 1: Which is the more economical brand of linseed meal to buy, one guaranteed to contain 32.5 per cent protein and 8 per cent fat, costing $36.50; or one containing 35 per cent protein, 6 per cent fat, costing $40 per ton?

Problem 2: Which is the more economical brand of wheat bran to buy, one guaranteed to contain 16.5 per cent protein and 4.5 per cent fat, costing $26 a ton, or one containing 13 per cent protein, 4 per cent fat, costing $23 a ton.

Problem 3: Which is the cheaper feed:

(a) Wheat at 80c a bushel or wheat bran at $24 a ton?

(b) Shelled corn at 60c a ton or hominy feed at $28 a ton?

(c) Sugar beets at $5 a ton or dried beet pulp at $25 a ton?

(d) Clover hay at $15 a ton, timothy hay at $14 a ton, or alfalfa hay at $18 a ton?

Problem 4: Cane molasses can be bought at 15c a gallon (12 pounds) and Indian corn at 60c a bushel (grinding 5c per cwt.); how much digestible matter is furnished for a dollar in either case?

Exercise 44. Comparative Manurial Values of Feeds

(Reference, Productive Feeding, Chapter XI, and Appendix Table V)

1. If a protein feed is needed to balance a ration, which one of the following feeds would be preferable, considering also manurial values: Wheat bran at $24.50 a ton, dried distillers' grains at $29.75, cottonseed meal at $35, linseed meal at $33, and tankage (60 per cent) at $50?

Arrange the feeds in order of

(a) Decreasing manurial values,

(b) Cost of digestible protein,

(c) Cost of total digestible matter.

Giving equal weight to (a) and (c), which would be the order of preference (1) when dairy cows are fed, and (2) when pigs are fed?

2. Calculate the manurial value in a ton each of the following feeds: wheat, wheat middlings, buckwheat middlings, cottonseed hulls, and red dog flour at the following prices: Nitrogen 20c a pound, phosphoric acid and potash each 5c a pound.

3. Is it advisable from the view-point of soil fertility to feed Indian corn worth 90c a bushel, when gluten feed can be bought at $25 a ton?

Exercise 45. A Study of Farm Fertility

1. What are the fertilizing ingredients in the manure worth, from a herd of milch cows fed the following amounts of feed during a certain period:

540 lbs. oats
620 lbs. Indian corn
210 lbs. linseed meal (O. P.)
4040 lbs. corn silage
2320 lbs. red clover hay,

the cost of the fertilizer elements being: nitrogen 18c per pound, phosphoric acid 4½c, potash 5½c.

2. (a) How much fertility would be sold if these feeds (except linseed meal) were sold off the farm; (b) how much when the milk which was produced (1½ tons) was sold for direct consumption, and (c) how much, if only the butter made from this milk (testing 3.9 per cent) was sold, the skim milk and butter milk being fed on the farm?

(a).....

(b).....

(c).....

B. RATIONS FOR FARM ANIMALS.

Exercise 46. Problems in Calf Raising

(Reference, Productive Feeding, Chapter XXI)

1. Make the best estimate you can of the amounts and cost of the feed consumed by a calf as raised by good dairymen in your section: (*a*) up to weaning; (*b*) to the end of the first year; (*c*) by a heifer during her first two years.

2. Calculate the feed cost for raising a calf to weaning, at current market prices, according to the following methods: (*a*) leaving it with the dam; (*b*) feeding whole milk for 4 weeks, then gradually substituting skim milk and feeding hay and a grain mixture composed of oats, Indian corn (or milo maize), wheat middlings and linseed meal, two parts of the first three, and one part of linseed meal; (*c*) feeding whole milk for 2 weeks only and then as given under *b*.

Exercise 47. The Wolff-Lehmann Standard for Dairy Cows

(Reference, Productive Feeding, Chapters VIII and XXII)

What are the digestible nutrients and the nutritive ratios of the three rations given below:

	Dry Matter, Pounds	Digestible		N. R.
		Protein, Pounds	Carbohydrates and Fat, Pounds	
(a)				
30 lbs. alfalfa hay.....				1:
(b)				
20 lbs. alfalfa hay.....				
30 lbs. corn silage.....				1:
(c)				
15 lbs. alfalfa hay.....				
25 lbs. corn silage.....				
5 lbs. barley				1:

Exercise 47 (Continued).

Give the amounts of dry matter and digestible nutrients that a cow weighing 1000 pounds and producing about 22 pounds of milk should receive in her daily ration, according to the Wolff-Lehmann Standard. Discuss in how far these requirements are met by the preceding three rations.

The Wolff-Lehmann Standard

	Dry Matter, Pounds	Digestible		N. R.
		Protein, Pounds	Carbohydrates and Fat, Pounds	
1000 lb. milch cow producing 22 lbs. milk daily				1:
Differences between standard and components in preceding rations:				
(a)				
(b)				
(c)				

Exercise 48. The Armsby Standard for Dairy Cows

(Same reference as for preceding Exercise)

What are the contents of digestible true protein and energy in the three rations given in the preceding exercise? (Use figures in Table III, Productive Feeding.)

	Digestible Protein, Pounds	Energy Values, Therms
(a)		
30 lbs. alfalfa hay.....		
(b)		
20 lbs. alfalfa hay.....		
30 lbs. corn silage.....		
(c)		
15 lbs. alfalfa hay.....		
25 lbs. corn silage.....		
5 lbs. barley.....		

Exercise 48 (Continued)

Give amounts of digestible protein and energy called for by the Armsby Standard for dairy cows under similar conditions as suggested in Exercise 47.

Discuss in how far these requirements are met by the preceding three rations.

The Armsby Standard

	Digestible Protein, Pounds	Energy Values, Therms
1000 lbs. milch cow maintenance		
22 lbs. milk		
Total		
Differences between standard and components in preceding three rations.		
(a)		
(b)		
(c)		

Exercise 49. The Haecker Standard for Dairy Cows

(Reference, Productive Feeding, Chapter XXII)

A 1200-pound cow producing 28 pounds of 4 per cent milk daily, receives the following daily ration:

20 pounds mixed clover and timothy hay, 34 pounds corn silage, 8 pounds of a mixture of corn meal, oats, dried distillers' grains (equal parts by weight) and one part each of linseed meal and gluten feed. How much total dry matter and digestible matter does the ration supply, and how does it compare with the Haecker Standard for dairy cows?

Suggest a modification that may seem desirable and show how it will affect the content of nutrients in the ration.

	Dry Matter, Pounds	Digestible		N. R.
		Protein, Pounds	Carbohydrates and Fat, Pounds	
20 lbs. mixed clover and timothy ...				
34 lbs. corn silage.....				
corn meal.....				
oats.....				
distillers' grains.....				
linseed meal.....				
gluten feed.....				
Total.....				1:
The Haecker Standard				
28 lbs. milk, 4 per cent				
Maintenance, 1200 lb. cow.....				
Difference.....				1:

Exercise 50. A Study of Rations for Dairy Cows

A herd of milch cows, weighing on the average about 1100 pounds, are each fed 10 pounds corn stover, 24 pounds corn silage, and 4 pounds corn meal per head daily, yielding on this feed with blue-grass pasture in summer, an average of 175 pounds of butter fat for the year. Suggest a change in the system of feeding which will bring the ration closer to the standard and increase the production of the cows. Calculate the cost per 100 pounds of milk and one pound butter fat, assuming that the herd milk tested 4.2 per cent for fat.

	Dry Matter, Pounds	Digestible		N. R.
		Protein, Pounds	Carbohydrates and Fat, Pounds	
10 lbs. corn stover				
24 lbs. corn silage				
4 lbs. corn meal				
				1:
The Wolff-Lehmann Standard (estimated daily production, ...lbs. milk)				1:
Ration as given above				
Suggested (feed added,).....lbs.				
				1:

Discuss variation from standard, and suggest further improvement in the composition of the ration.

Exercise 51. Formulating Rations for Dairy Cows[1]

1. Make up a ration from the following feeds for a dairy cow weighing 1150 pounds and yielding 25.4 pounds milk a day:

Corn silage, mixed clover and timothy hay, gluten feed and wheat bran.

Compare with feeding standards and calculate cost per day at current market prices and feed cost per 100 pounds of milk and per pound of butter fat, assuming the fat content of the milk to be 3. 8 per cent.

2. Make up a ration from the following feeds for a dairy cow weighing 925 pounds and yielding 16.3 pounds milk (4.9 per cent fat):

Clover hay (limited supply), corn silage, corn meal, wheat middlings and linseed meal (O. P.). Calculate cost of ration and average cost of milk and butter fat as under No. 1.

[1] Study carefully points to be considered in formulating rations, in Productive Feeding, close of Chapter VIII, before writing this and similar exercises given in the Manual. In this and the following ration exercises draw forms similar to that used in Exercise 50.

3. If mixed hay, corn stalks, ground oats and corn meal are available and represent the cheapest feeds on the market, what proportion of each had better be fed to a dairy herd; suggest an improvement in the ration by purchasing a small amount of some feed that will tend to balance the ration at a minimum cost, according to local market prices.

Exercise 52. Formulating Rations for Dairy Cows

1. Formulate a ration for the dairy herd made up of home-grown feeds only. Show how it may be modified by the purchase of a commercial feeding stuff; (*a*) with regard to nutritive effect only, (b) with regard to both cost and nutritive effect.

2. Five tons of alfalfa hay and 4 tons beets (mangels) make a sufficient amount of feed for a cow producing 300 pounds of butter fat in a year. Calculate the average daily ration, and compare with the Wolff-Lehmann and Armsby standards. Suggest a modification of the ration that you may consider will tend to increase its efficiency.

Exercise 53. Formulating Rations for Dairy Cows

1. What improvement can you suggest in a ration for a dairy cow that is receiving alfalfa hay and wheat bran only? How much of these two feeds should a 1200-pound cow receive when yielding 23 pounds of milk (3.8 per cent fat)?

2. Make up a balanced ration for a dairy cow (weight 1150 pounds, producing 36.5 pounds of 3.5 per cent milk), from the following feeds:

(a) Clover hay and corn-and-cob meal.

(b) Corn fodder, corn meal, wheat bran and cottonseed meal.

(c) Pea-vine hay, cottonseed meal, cottonseed hulls.

(d) Alfalfa hay, corn silage, milo, barley.

Exercise 54. Formulating Rations for Dairy Cows

Formulate a balanced ration for a 1000-pound milch cow from the two feeds, oat straw and linseed meal, according to the Wolff-Lehmann Standard. Will this make an effective practical ration?—if not, give reasons why. Introduce one or two other feeds that will make up a desirable ration to feed good dairy cows.

2. The following grain mixture is fed in a dairy herd: 200 pounds corn-and-cob meal, 100 pounds each of wheat bran and ground oats, and 50 pounds linseed meal.

Calculate the digestible components, nutritive ratio and weight per quart of this mixture.

How many pounds should be fed with a good quality of mixed hay, when fed to cows producing 25 pounds of 3.6 per cent milk?

How much mixed hay, and how much hay and corn silage, should the cows receive with the grain mixture to make a balanced ration? What modification in the grain mixture would you recommend, if clover hay were the only available roughage?

Exercise 55. Formulating Rations for Dairy Cows

1. A cow consumed the following amounts of feed during one year: 1000 pounds of mixed hay, 100 pounds alfalfa hay, 6000 pounds corn silage, 600 pounds of soiling crops (green sorghum), 600 pounds each of wheat bran and corn meal, 80 pounds of linseed meal, and 365 pounds distillers' grains. She was on limited pasture 150 days. Her production for the year was 7180 pounds milk and 306 pounds butter fat; average body weight 1040 pounds.

Calculate total feed units eaten, estimating one pasture day equal to 8 feed units; also average feed units per day, feed units per 100 pounds milk and per pound butter fat.

Calculate cost of ration at average local feed prices; also feed cost per 100 pounds milk and per pound butter fat.

2. A dairy herd producing, on the average, 6800 pounds of 4 per cent milk per head annually, receives the following feed during the year: mixed clover and timothy hay, Indian corn silage, corn stover, ground corn and oats, malt sprouts and linseed meal, in amounts that enable the cows to maintain a high production and keep in good body condition. Formulate a ration that will bring this about at a minimum feed cost, figuring the feeds at ordinary market prices, and including 150 pasture days, for which a charge of $1.50 a month is made. Calculate the feed cost per quart of milk and per pound of butter fat, under the system of feeding recommended.

Exercise 56. Criticisms of Rations for Dairy Cows

1. What criticisms do you have to offer of the following rations for dairy cows:

(a) Corn silage 30 pounds, gluten meal 4 pounds, Indian corn 3 pounds.

(b) Wheat hay 20 pounds, flour middlings 5 pounds, wheat bran 3 pounds.

(c) Oat hay 20 pounds, oat shorts 8 pounds.

Calculate nutrients in these rations, and, if possible, look up Wisconsin Station Research Bulletin 17, and discuss the problem presented by them.

2. Compare the following two rations for dairy cows as to digestible nutrients and feed cost, assuming that they have proved equally effective for milk production, producing 32 pounds of 4.5 per cent milk:

(a) Fifteen pounds alfalfa hay, 5 pounds corn stalks, 40 pounds mangels, 4 pounds corn meal, 3 pounds ground oats.

(b) Fifteen pounds alfalfa hay, 20 pounds silage, 3 pounds hominy feed, one pound each of linseed meal and dried distillers' grains.

What was the average feed cost per 100 pounds of milk and per pound of butter fat in either case at current feed prices?

Exercise 57. Rations for Dairy Cows on Official Tests

1. The following daily ration is fed a high-producing cow weighing 1500 pounds: 40 pounds corn silage, 35 pounds alfalfa hay, 8 pounds barley, 7 pounds dried beet pulp, 4 pounds wheat bran.

Calculate the digestible nutrients in the ration and compare with standards. How much butter fat should a cow produce to be entitled to such a ration?

2. Make calculations as in the preceding ration with the following ration: 30 pounds Indian corn silage (from well-eared, nearly mature corn), 10 pounds clover hay, 35 pounds sugar beets, 21 pounds of a grain mixture consisting of bran, ground oats, gluten feed, equal parts by weight, and 3 pounds linseed meal.

Exercise 58. Relative Economy of Dairy Feeds

(Reference, Productive Feeding, Chapter X)

1. Compare *alfalfa hay* and *wheat bran* as components of rations for dairy cows or beef cattle and give relative feeding value as indicated by (a) total digestible components, (b) energy values, (c) feed-unit system, and (d) results of actual comparative trials. At ordinary market prices, which one is the more economical of the two feeds?

2. Calculate the relative economy of the following feeds at the market prices given, according to contents of total digestible matter, energy values and feed-unit system, viz.:

(a) Alfalfa hay at $18 a ton, corn meal at $32 a ton, barley at $28, wheat bran at $24. Give order of preference for the purpose of making up rations for dairy cows.

(b) Corn silage at $3.50 a ton, alfalfa hay at $15 a ton, timothy hay at $18, and sugar beets at $6 a ton.

(c) Barley at $25 a ton, Indian corn at $32, wheat bran at $24, wheat middlings at $25.50, linseed meal at $38, and cottonseed meal at $36 a ton.

Exercise 59. Relative Economy of Dairy Feeds

1. Compare the average yield of green feed, of total dry matter and of digestible nutrients obtained during the season in your state from an acre of (a) Indian corn, (b) alfalfa, (c) timothy hay and (d) mangels. Make the best estimate of the cost of production per acre and per ton of these crops that you can, and place the crops in their proper order of preference, according to your results, as to economy of production per ton of gross yields, total dry matter, and digestible nutrients.

2. Which are the most economical feeds for supplementing alfalfa for dairy cows: Indian corn at $1.80 per 100 pounds, barley $1.25, wheat bran $1.20, wheat middlings $1.35 and corn silage at $2.50 per ton? Give order of preference according to (a) content of total digestible matter, (b) energy values, and (c) feed units.

Give a practical ration selected from the preceding feeds for a 1200-lb. cow yielding 22 lbs. of 4 per cent milk, according to Wolff-Lehmann, Armsby, and the feed-unit system.

Exercise 60. A Study of Dairy Herd Management

1. A dairy herd consists of twelve milch cows, three of which are heifers with first calves. The daily production of the herd is as follows, that of the cows being given first, and that of the heifers last:

No	Milk per Day, Pounds	Per cent of Butter Fat	In Milk, Months
1	24.0	3.9	2
2	15.3	4.7	5
3	32.5	3.5	1
4	12.2	4.5	7
5	18.7	3.7	6
6	10.3	3.2	4
7	25.0	3.6	2
8	8.6	4.1	8
9	14.2	3.8	3
10	5.7	4.6	6
11	12.3	4.5	5
12	7.6	3.3	9

Should any of these cows or heifers be disposed of as unprofitable? Place them in order of decreasing daily production of butter fat.

2. Give a good method of feeding cows to be disposed of; also state the kinds and amounts of grain feed to be fed the individual cows when—(a) alfalfa, clover or cowpea hay is fed; (b) corn silage and corn stover are fed.

Exercise 61. Feeding Different-sized Dairy Herds

Outline a practical system of feeding:

(a) A single-cow dairy.

(b) A 25-cow dairy in your own locality.

Give total amounts of feed and cost at prevailing market prices in both cases, and calculate the returns from the dairies on basis of an average production of, respectively, 1.5 pounds and 0.7 pound of butter fat, valued at 30c a pound.

Exercise 62. Soiling Crops for Dairy Cows

(Reference, Productive Feeding, Chapter XII)

1. Suggest a succession of soiling crops adapted to conditions in your state, for a herd of 25 milch cows producing, on the average, a pound of butter fat a day, green feed to be provided from May 1 to October 15, in amounts of 30 to 60 pounds per head daily, according to the crops used. Estimate the yields and acreage of the different crops, and the dates between which they may be cut for green feed.

Calculate the amounts of hay (a small feed daily) and the kinds and amounts of concentrates to be fed in addition to the soiling crops during the period given.

2. Calculate the approximate cost of growing, harvesting, and feeding the soiling crops given in (1) and, for the sake of comparison, estimate the amounts and cost of the corn silage that would be required to furnish equivalent amounts of feed materials for the period given, as in case of the green feed.

Exercise 63. Value of Alfalfa Pasture

1. What is the carrying-capacity of a good 3-year-old alfalfa pasture for

	Alfalfa Alone	Pasture with light Grain Feed.
(a) dairy cows.....	.....	
(b) fattening steers.....	.....	
(c) sheep.....	.....	
(d) 3-months-old pigs.....		

2. How much alfalfa pasturage will be required to carry a herd of 32 dairy cows, yielding on the average 23.5 pounds of 4 per cent milk, from May 15 to October 1? The herd will receive, in addition to pasture, a light feed of hay from mixed grasses and an amount of grain feed equivalent to 7 times the yield of butter fat.

3. Calculate the pounds of feed units consumed daily by the cows on this feed, estimating a pasture day at 12 feed units. Also the cost of the feed eaten, according to current market prices and with pasture at $1.50 a month per head, butter fat being worth 32c a pound and skin milk 25 cents a hundred.

4. Calculate the returns obtained from an acre of alfalfa by the system of feeding outlined.

Exercise 64. Comparison of Feeds for Fattening Steers

(Reference, Productive Feeding, Chapter X)

What is the relative value of the following feeds for fattening steers, at the prices given, according to their contents of digestible nutrients and their energy and feed unit values:

Clover hay $12 a ton, corn stalks $4 a ton, alfalfa hay $15, shelled corn 50 cents a bushel, oats 50 cents a bushel, and wheat bran $25 a ton.

Comparison of Cost of Feeds

	Cost per 100 lbs.	Digestible Matter		Energy Values		Feed Units	
		Total	Per lb.	Therms	Per Therm	Total	Per Unit
1. Clover hay.....							
2. Corn stalks.....							
3. Alfalfa hay.....							
4. Shelled corn....							
5. Oats.....							
6. Wheat bran....							

Order of preference:

According to digestible matter: Nos.

According to energy values: Nos.

According to feed units: Nos.

Exercise 65. Rations for Fattening Steers

Change each of the following three maintenance rations into a productive ration by the addition of one or more common concentrates:

1. Corn stalks 10 pounds, clover hay 5 pounds.
2. Clover hay 10 pounds, corn silage 15 pounds.
3. Alfalfa hay 8 pounds, corn stalks 6 pounds.

Reduce the roughage if need be, in order to make an effective ration.

	Digestible Matter, Pounds	Digestible		N. R.
		Protein, Pounds	Carbohydrates and Fat, Pounds	
1.				
10 lbs. corn stalks.....				
5 lbs. clover hay.....				
lbs.				
2.				
10 lbs. clover hay.....				
15 lbs. corn silage.....				
lbs.				
3.				
8 lbs. alfalfa hay.....				
6 lbs. corn stalks.....				
lbs.				

Exercise 66. A Study of Rations for Fattening Steers

(Reference, Productive Feeding, Chapter XXIII)

Calculate the nutrients and nutritive ratios in the two following rations for fattening steers. Which ration would be likely to produce the largest gains and which the cheapest gains at current prices for feeds?

1. 15 pounds shelled corn, 3 pounds linseed meal, 17 pounds corn silage, and 2 pounds alfalfa hay.

2. 5 pounds linseed meal, 38 pounds corn silage, and 4 pounds alfalfa hay.

Components of Rations

	Dry Matter, Pounds	Digestible		N. R.
		Protein, Pounds	Carbohydrates and Fat, Pounds	
15 lbs. shelled corn				
3 lbs. linseed meal				
17 lbs. corn silage				
2 lbs. alfalfa hay				
5 lbs. linseed meal				
38 lbs. corn silage				
4 lbs. alfalfa hay				
Wolff-Lehmann Standard for 1000 pound steers				

Exercise 67. Problems in Steer Feeding

(Reference, Productive Feeding, Chapter XXIII)

1. A bunch of 25 steers averaging 850 pounds are bought at 7 cents a pound, and fed a ration composed of the following feeds for a period of 120 days: Corn silage, corn stover, ear corn, wheat bran, distillers' grains, linseed meal. In what proportions and amounts should these feeds be fed in order to have the steers gain 2 pounds a day or better?

At what price must they be sold to enable the owner to make 10 per cent on his investment, allowing a 3 per cent shrinkage?

2. With feeders selling at 7 cents a pound, alfalfa at $12 a ton, corn at 75 cents a bushel, barley at 60 cents a bushel, oat straw at $6 a ton, and corn silage worth $3 a ton, how much must fattening steers bring after a feeding period of 90 days, in order to return a fair profit to the owner?

Exercise 68. A Study of Rations for Horses

(Reference, Productive Feeding, Chapter XXIV)

What are the amounts of dry matter and digestible nutrients in the following rations, and how do these compare with the Wolff-Lehmann Standard for horses of 1200 pounds weight, doing medium work?

	Dry Matter, Pounds	Digestible		N. R.
		Protein, Pounds	Carbohydrates and Fat, Pounds	
(a)				
10 lbs. alfalfa hay				
12 lbs. barley				
(b)				1:
10 lbs. alfalfa hay				
10 lbs. Indian corn				
(c)				1:
14 lbs. timothy hay				
12 lbs. oats				
Wolff-Lehmann Standard				1:
Difference				
(a)				
(b)				
(c)				

Exercise 69. A Study of Rations for Horses

1. Compare the following rations for a 1000-pound horse or mule doing heavy work, with the Wolff-Lehmann and the feed-unit standards:

(a) Twelve pounds pea-vine hay, 6 pounds blackstrap (cane) molasses, 8 pounds corn-and-cob meal, 2 pounds cottonseed meal.

(b) Ten pounds corn fodder, 5 pounds pea-vine hay, 10 pounds Indian corn, 1½ pounds cottonseed meal.

2. Calculate the nutrients in the following rations for farm horses of about 1200 pounds weight, doing moderate work, and discuss the rations with special reference to their nutritive ratios:

(a) Eighteen pounds alfalfa hay, 5 pounds oats, 5 pounds barley, 2 pounds distillers' grains.

(b) Fifteen pounds mixed clover and timothy hay, 10 pounds corn-and-cob meal, 5 pounds oats.

(c) Fifteen pounds timothy hay, 5 pounds corn stover, 3 pounds each of oats and dried brewers' grains, 6 pounds wheat bran.

Suggest changes that will make them more effective without increasing the cost appreciably at local feed prices.

Exercise 70. A Study of Rations for Horses

1. Formulate a balanced ration for a 1200-pound horse doing medium work from the following feeds: Timothy hay, oats, dried brewers' grains, and coconut meal.

	Dry Matter, Pounds	Digestible		N. R.
		Protein, Pounds	Carbohydrates and Fat, Pounds	
....lbs. timothy hay.....				
....lbs. oats.....				
....lbs. dried brewers' grains.....				
....lbs. coconut meal.....				
				1:

2. The following concentrates are fed to heavy-worked horses, weighing 1500 pounds: Oats 8 pounds, shelled corn 5 pounds, wheat bran 2 pounds per head daily. How many pounds of timothy hay are required to balance the ration according to the Kellner-Armsby Standard?

	Dry Matter, Pounds	Digestible		N. R.
		Protein, Pounds	Carbohydrates and Fat, Pounds	
8 lbs. oats.....				
5 lbs. corn.....				
2 lbs. wheat bran.....				
....lbs. timothy hay.....				
				1:
Kellner-Armsby Standard.....				
Difference.....				

Exercise 71. A Study of Rations for Horses

Calculate the nutrients in the following rations for heavy-worked horses. Suggest an improvement in each ration by changes in the amounts of the feeds or addition of some other standard horse feed.

1. 10 pounds alfalfa hay, 15 pounds Indian corn.
2. 20 pounds timothy hay, 15 pounds oats.
3. 15 pounds alfalfa hay, 11 pounds oats, 2 pounds cottonseed meal.

4. 9 pounds alfalfa hay, 15 pounds oats.
5. 8 pounds timothy hay, 7 pounds alfalfa hay, 15 pounds oats.
6. 15 pounds timothy hay, 10 pounds molasses, 5 pounds corn.

Exercise 72. Rations for Colts, Mares and Work Horses

Select from the common feeds in your locality, a good ration for: (a) horses doing heavy work, (b) idle horses, (c) brood mares, (d) growing colts, and (e) horses to be fattened.

Compare the rations with the Wolff-Lehmann and the Kellner-Armsby standards.

(a)

(b)

(c)

(d)

(e)

Question 1. How does the character of the feed affect the amount of water drunk by the horses?

Question 2. Is corn silage a good feed for horses; if so, under what precautions and in what amounts should it be fed?

Exercise 73. A Problem in Horse Raising

Make a careful calculation of the amounts and cost of the grain and hay eaten by growing colts, and the length of the pasture period up to the end of (a) the first year, and (b) the second year.

Exercise 74. Rations for Fattening Pigs

1. A bunch of pigs 4 months old are fed the following ration: 3 pounds corn meal, 1 pound wheat middlings, 10 pounds skim milk.

	Dry Matter, Pounds	Digestible		N. R.
		Protein Pounds	Carbohydrates and Fat, Pounds	
3 lbs. corn meal.....				
1 lb. middlings.....				
10 lbs. skim milk.....				
Total.....				
Standard.....				

Is it a balanced ration?.....If not, what changes would you suggest?

2. Two-months old pigs are fed a slop of water and 6 parts corn meal, 3 parts middlings, and 1 part tankage. How does this ration compare in nutritive effect and cost with one composed of 1 part corn meal to 3 of skim milk at ordinary current market prices for feeds?

Exercise 75. Rations for Fattening Pigs

(Reference, Productive Feeding, Chapter XXV)

1. Describe the method of raising pigs on your farm or on some farm with which you are acquainted, with special reference to the system of feeding practiced. If unable to do so, describe the method adopted by the Hog Department at your college or school.

2. Give ratio of skim milk to grain that will give the best results in pig feeding. What proportion is fed in case skim milk is scarce, and what proportion when an abundant supply is available? What can one afford to pay for skin milk when corn (grain) is worth $32 a ton?

Exercise 76. Feeding Market Pigs[1]

The following rations are fed to fattening pigs: (a) 3 to 6 months old: 120 pounds corn meal, 25 pounds red dog flour, 10 pounds digester tankage; (b) 6 months to 1 year old: 100 pounds ear corn, 5 pounds digester tankage.

What is the nutritive ratio of these mixtures and how much are the pigs likely to clean up?

	Dry Matter, Pounds	Digestible		N. R.
		Protein, Pounds	Carbohydrates and Fat, Pounds	
(a)				
120 lbs. corn meal				
25 lbs. red dog flour				
10 lbs. tankage				
Total				1:
(b)				
100 lbs. ear corn				
5 lbs. tankage				
Total				1:

[1] New Jersey Report 34.

Exercise 77. A Ration for Brood Sows with Litters[1]

How much dry matter and total digestible nutrients does the following ration for brood sows with litters contain? How is it preferably fed and in about what amounts daily, per sow: 100 pounds corn meal (or its equivalent in ears), 10 pounds digester tankage, 15 pounds wheat bran, 5 pounds linseed meal, 2 pounds steamed bone meal.

[1] New Jersey Report 34.

Exercise 78. A Problem in Pig Feeding

Describe a practical system of feeding a bunch of 50 2-months-old pigs through the summer and fall, on alfalfa pasture with concentrates, until they have reached a weight of 180 to 200 pounds.

How large a pasture will it take and what are the amounts and cost of concentrates required to get the pigs ready for market at 8 months old?

At ordinary market prices for concentrates, and with pork at 7 cents, what returns are obtained per acre of alfalfa by feeding the pigs in the manner suggested?

Exercise 79. A Study of Rations for Growing Sheep

(Reference, Productive Feeding, Chapter XXVI)

Which of the following rations comes closest to the Armsby Standard for 9-months old sheep:

1. Three lbs. alfalfa hay, ¾ pound Indian corn.
2. Two lbs. clover hay, ½ pound wheat bran, and ½ pound Indian corn.
3. One and one half pounds shredded corn stover, 1 pound gluten feed, ¼ pound Indian corn.

What is the relation between the cost of the rations, at ordinary market prices, and the nutritive effects they are likely to have, judging by closeness to the feeding standard?

	Dry Matter, Pounds	Digestible Protein, Pounds	Energy Values, Therms
1. 3 lbs. alfalfa hay			
¾ lb. Indian corn			
2. 2 lbs. clover hay			
½ lb. wheat bran			
½ lb. Indian corn			
3. 1½ lbs. corn stover			
1 lb. gluten feed			
¼ lb. corn			
The Armsby Standard			

Exercise 80. Rations for Fattening Lambs

Are any changes desirable in the following rations for 70-pound fattening lambs in order to bring them closer to the Wolff-Lehmann Standard?

1. One and one-half pounds clover hay, ½ pound Indian corn, ¼ pound dried beet pulp, and ¼ pound linseed meal.

2. One pound mixed hay, ½ pound corn stover, ½ pound oats, and ½ pound wheat bran.

	Dry Matter, Pounds	Digestible		N. R.
		Protein, Pounds	Carbohydrates and Fat, Pounds	
1. 1½ lbs. clover hay				
½ lb. corn				
¼ lb. dried beet pulp				
¼ lb. linseed meal				
				1:
2. 1 lb. mixed hay				
½ lb. corn stover				
½ lb. oats				
½ lb. wheat bran				
				1:
Wolff-Lehmann Standard				

Exercise 81. A Study of Poultry Feeds[1]

(Reference, Productive Feeding, Chapter XXVII)

Examine each sample of feed carefully and fill out the outline below.

Examination of Poultry Feeds

Sample No.	Name	Grain or Mill Feed	Color	Smell	Taste	Size and Shape if a Grain, Coarseness if a Mill Feed
1						
2						
3						
4						
5						
6						

Sample No.	Quality	Per cent Fiber, Low, Medium, High	Per cent Digestible Protein	Per cent Digestible Carbohydrates and Fat	N. R.	Price Per lb.
1						
2						
3						
4						
5						
6						

[1] Exercises 81–82, contributed by Prof. J. E. Dougherty, Univ. of California.

Exercise 82. A Study of Poultry Rations

(Reference, Productive Feeding, Chapter XXVII)

1. Weigh out the feeds in the mixtures given below, mix them thoroughly and observe the following points: (a) bulk, (b) coarseness, (c) fiber content, (d) palatability, and (e) if ground feed, mix with water and note crumbliness or stickiness. Determine nutritive ratio of each and cost per pound.

Grain

15 lbs. wheat.
15 lbs. barley, whole or rolled.
5 lbs. corn, whole Egyptian or cracked Indian corn.

Mash

5 lbs. each of wheat bran, shorts or brown middlings, ground barley or oats.
2 lbs. soybean meal or linseed meal.
3 lbs. meat scraps.
½ lb. fine charcoal.
$\frac{1}{10}$ lb. salt (1 lb. in 200 lbs. mash).

Exercise 82 (Continued)

1. The mash ration may be altered by reducing the amount of soybean meal or linseed meal one-half and adding a pound of alfalfa meal, or the alfalfa meal could be substituted for the ground barley. What would be the ratio and cost with this change?

2. In case wheat becomes too expensive to be fed economically, it might be reduced in the above ration by using equal parts by weight of wheat, Indian corn, barley and Egyptian corn (or milo).

3. A still further reduction in wheat used would be secured by mixing equal parts of wheat, Indian corn, Egyptian corn or milo, barley and oats.

4. If it were necessary to entirely eliminate wheat, a mixture of equal parts of Indian corn, oats and Egyptian corn or milo might be fed in the morning with a feed of soaked barley (soaked for 24 hours) at night. A number of combinations quite similar in character could be used in periods of high prices.

What would be the nutritive ratio and cost of each in 2, 3, and 4?

Note the difference in cost from the original mixture?

Digestion Coefficients of Common Feeding Stuffs, in Per Cent

(Various authorities)

Feeding Stuffs	Dry Matter	Protein	Fat	Fiber	N-free Extract
Green alfalfa	61	74	39	43	72
Timothy hay	55	48	50	50	62
Meadow hay	61	57	50	62	62
Alfalfa hay	62	72	43	47	72
Red clover hay	61	62	62	49	69
Indian corn fodder (cured)	66	45	70	63	73
Corn stalks	57	36	67	64	59
Oat straw	48	33	36	54	46
Corn silage	66	51	82	65	71
Mangels	87	70	..	37	95
Sugar beets	..	72	..	34	97
Corn meal	88	66	91	..	92
Corn-and-cob meal	79	52	84	45	88
Oats	70	77	89	31	77
Barley	86	70	89	50	92
Milo maize	80	57	88	100	84
Buckwheat feed [1]	62	67	70	36	71
Grain screenings	79	75	94	65	85
Wheat bran	66	77	63	41	71
Wheat middlings, flour	82	88	86	36	88
Wheat middlings, standard (shorts)	..	77	88	30	78
Red dog flour	87	88	36	..	88 [2]
Pea meal	87	83	55	26	94
Gluten feed	87	85	82	76	89
Brewers' grains, dried	62	80	90	50	60
Distillers' grains, dried	79	73	95	95	81
Linseed meal (O. P.)	79	89	89	57	78
Cottonseed meal	77	83	94	35	78
Cottonseed hulls	41	6	79	47	34
Coconut meal	80	78	97	63	83
Beet pulp, plain dried	77	51	..	72	86
Beet pulp, molasses	83	62	..	80	91
Cane molasses (blackstrap)	78	32	..	..	90
Skim milk	98	95	00	..	100
Tankage	92	97	187	..	..

[1] Calculated. [2] Assumed.

SUGGESTED APPARATUS

1.	One analytical balance, capacity 200 grams to one milligram	$15.00
2.	One set metric weights, 100 grams to one milligram	2.75
3.	One Barnes dissecting microscope	1.50
4.	One tripod magnifier	.70
5.	One gross 3 x 1 inch slides	.85
6.	One ounce No. 2 circular covers, 18 mm. diameter	.60
7.	One forcep, medium straight, 120 mm. long	.45
8.	Petri dishes, 4 inches, with covers	3.00
9.	One dropping bottle, one ounce	.20
10.	Two Griffin beakers, 100 c.c	.48
11.	One scalpel, ½ inch	.25
12.	5½-inch brass sieves, one 50-inch mesh	.70
13.	One set of two sieves, 20- and 80-inch mesh, with cover and pan	1.50
		$27.74